Environmental Restoration Program

Final
Site Inspection Report for Site 40 (AOC 73)
Electronic Deliverable

CDRL A001E
Paragraph 9.7.1

Prepared for
Beale Air Force Base
Beale Air Force Base, California 95903-1708

Contract No. F41624-03-D-8595
Task Order 0165
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March 31, 2006

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Lt. Col. Chris Williston
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Subject: Beale Air Force Base
Environmental Restoration Program
Electronic Deliverable
Final Site Inspection Report for Site 40 (AOC 73)
CDRL A001E; Paragraph 9.7.1
Project No. BAEY2004-7073; Contract No. F41624-03-D-8595
Task Order 0165

Dear Lt. Col. Williston:

The purpose of this letter is to submit the *Electronic Deliverable Final Site Inspection Report for Site 40 (AOC 73)*. This submittal satisfies the requirement for Project No. BAEY2004-7073; CDRL A001E; Paragraph 9.7.1; Contract No. F41624-03-D-8595 for Task Order 0165.

One copy of the *Electronic Deliverable Final Site Inspection Report for Site 40 (AOC 73)* was mailed to Mike O'Brien at Beale Air Force Base on March 31, 2006. Copies of this document have been delivered to the individuals listed on the attached distribution.

If you have any questions concerning this submittal, I can be reached at 916/920-0300, Extension 279.

Sincerely,

CH2M HILL

Charles S. Elliott, Jr.

Chuck Elliott
Basewide Groundwater Monitoring Program Manager

Enclosures

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SECTION 1

Introduction

This document presents the results of the Site 40 (formerly known as Area of Concern [AOC] 73) Site Inspection (SI). An unknown source(s) has contaminated groundwater at Site 40, primarily with volatile organic compounds (VOCs). The SI was performed in 2004-2005 and employed the Triad method of field investigation.

1.1 Environmental Restoration Program

The objective of the Air Force Environmental Restoration Program (ERP) is to assess past hazardous waste disposal and spill sites at Air Force installations and to develop remedial actions consistent with the National Contingency Plan (NCP) for sites that pose a threat to human health and welfare or the environment. The ERP was formally known as the Installation Restoration Program (IRP), as referenced in this section. This section presents information on the IRP program origins, objectives, and organization.

The 1976 Resource Conservation Recovery Act (RCRA) is one of the primary federal laws governing the disposal of hazardous wastes. Sections 6001 and 6003 of RCRA require federal agencies to comply with local and state environmental regulations and to provide information to the U.S. Environmental Protection Agency (USEPA) concerning past disposal practices at federal sites. RCRA Section 3012 requires state agencies to inventory past hazardous waste disposal sites and provide information to the USEPA concerning those sites.

In 1980, Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, commonly known as Superfund). CERCLA outlines the responsibilities for identifying and remediating contaminated sites in the United States and its possessions. CERCLA legislation identifies the USEPA as the primary policy and enforcement agency regarding contaminated sites.

The 1986 Superfund Amendments and Reauthorization Act (SARA) extended the requirements of CERCLA and modified CERCLA with respect to goals for remediation and the steps that lead to the selection of a remedial process. SARA is the primary legislation governing remedial action at past hazardous waste disposal sites.

Executive Order 12580, adopted in 1987, gave various federal agencies, including the Department of Defense (DOD), the responsibility to act as lead agencies for conducting investigations and implementing remediation efforts when they are the sole or co-contributor to contamination on or off their properties. To ensure compliance with CERCLA, its regulations, and Executive Order 12580, the DOD developed the IRP (now known as the ERP), under the Defense ERP, to identify potentially contaminated sites, investigate these sites, and to evaluate and select remedial actions for potentially contaminated facilities.

The DOD issued the Defense Environmental Quality Program Policy Memorandum (DEQPPM) 80-6 regarding the IRP program in June 1980, and implemented the policies

outlined in this memorandum in December 1980. The NCP was issued by USEPA in 1980 to provide guidance on a process by which the following would occur:

- Reporting of contaminant releases
- Identification and quantification of contamination
- Selection of remedial actions

The NCP describes the responsibilities of federal and state governments and those responsible for contaminant releases.

The DOD formally revised and expanded the existing IRP directives and amplified all previous directives and memorandums concerning the IRP through DEQPPM 81-5, dated December 11, 1981. The memorandum was implemented by an Air Force message dated January 21, 1982. The ERP is the DOD's primary mechanism for response actions on Air Force installations affected by the provisions of SARA. Over the years, ERP requirements have been developed and modified to ensure that DOD complies with federal laws, such as RCRA, NCP, CERCLA, and SARA.

1.2 Historical Environmental Restoration Program Work at Beale AFB

Beale Air Force Base (AFB) covers approximately 22,944 acres located entirely within Yuba County, California. The base is located in the Sacramento Valley, approximately 40 miles north of Sacramento and 13 miles east of Marysville, as shown on Figure 1-1. Currently, the Base is within the jurisdiction of the Air Combat Command and has responsibility for global reconnaissance operations.

In October 1942, Beale AFB opened as U.S. Army Camp Beale and served as a training ground for infantry and armor units. During World War II, Camp Beale was also used as a personnel deployment depot and prisoner-of-war encampment, and was the site of a large hospital. As many as 60,000 personnel were stationed at Camp Beale at that time.

After World War II, Camp Beale was transferred to the Air Force. From 1948 to 1951, it was known as the Beale Bombing and Gunnery Range and was used for bombardier and navigator training. In 1951, the range was designated as Beale AFB, and was under several jurisdictions, including the Air Training Command, the Aviation Engineering Force, the Strategic Air Command, and the Air Combat Command. The first runway became operational in 1958.

Over the years, Beale AFB has been associated mainly with Air Force refueling and reconnaissance missions. In 1959, Beale AFB received its first KC-135 Stratotanker jet, which was assigned to the 903rd Air Refueling Squadron of the 456th Bombardment Wing. B-52s were assigned to the base between 1960 and 1976. The 420th Strategic Reconnaissance Wing was activated in 1965. In 1976, the 9th Strategic Reconnaissance Wing was assigned to Beale AFB. Such aircraft as the U-2 and the SR-71 have been associated with the reconnaissance wings (CH2M HILL, 1991).

Beale AFB is not a National Priorities List site. However, the Air Force addresses ERP sites in a manner consistent with CERCLA guidance and policy. The overall ERP management

strategy at Beale AFB follows site investigation and restoration under the Streamlined Environmental Restoration Approach developed by the Air Force, the California Environmental Protection Agency's (Cal/EPA) Department of Toxic Substances Control (DTSC), and California State Regional Water Quality Control Board (RWQCB).

Basewide contamination source discovery and assessment is conducted by the Restoration Element of the Environmental Flight, and began in the early 1980s with a Phase I Records Search (Engineering-Science, Inc. [ESI], 1984). Available base records and aerial photographs were reviewed to identify historical chemical, fuel storage, or waste management areas, and reported hazardous substance releases (spills). The investigation resulted in the identification of sites that were scheduled for action under the base's IRP.

A Phase II, Stage 1 Confirmation/Quantification Study of IRP sites was conducted in 1985. A Stage 2-1 Remedial Investigation (RI) was conducted in 1988. Soil and water sampling, geophysical surveys, and additional records searches were also conducted during this time (CH2M HILL, 1991), and basewide groundwater monitoring was conducted periodically.

Since 1991, Remedial Investigation/Feasibility Study (RI/FS) efforts have been expanded or initiated to address sites across Beale AFB. As of September 2005, the Beale AFB ERP includes 40 sites and 73 AOCs. No Further Action decisions have been completed for 16 ERP sites (2, 4, 5, 7, 9, 14, 19, 20, 24, 25, 26, 27, 28, 30, 34, and 36); two (Sites 6 and 15) have been transferred to the Compliance Element of the Environmental Flight; four (Sites 19, 21, 24, and 33) are pending closure; and 962 tank sites have been closed under Site 22 (all tanks). Fifty-six AOCs have been closed, 14 were carried over to ERP sites, one AOC was transferred to the Compliance Element (22), and two were transferred to the Munitions Response Program (24 and 59).

1.3 Current Project

On January 5, 2004, the Air Force Center for Environmental Excellence (AFCEE) issued Task Order No. 0165 (BAEY 2004-7073) on Contract number F41624-03-D-8595 to CH2M HILL. The Task Order includes a preliminary assessment (PA) of AOC 73, an SI, and reporting. The scope for this effort is described in the AFCEE Statement of Work, dated January 5, 2004. This SI Report fulfills contract data requirements list (CDRL) A001E and A001F. This document has been developed to summarize the findings of the SI, present the current Site 40 conceptual model, and make recommendations for future work at the site.

1.3.1 Site Investigation Approach

The SI was performed using the Triad Approach, which offers an opportunity to achieve savings in time and money by reducing the number of investigation cycles needed to characterize a site. The key to the Triad Approach is a *dynamic* work plan that emphasizes adaptive approaches in the field. In other words, the work plan approach may be modified based on field observations during the field investigation. The Triad Approach is composed of three interconnected concepts: systematic planning, dynamic work plans, and real-time measurement technologies (ITRC, 2003).

In order for the Triad Approach to be successful, it is important to assemble a team of environmental professionals who are capable of translating project goals into clear technical objectives, and make needed decisions during the investigation. At Beale AFB, this team

consisted of a Tier 1 subgroup including Air Force personnel, regulators, and contractors. The primary members of this team were Michael O'Brien (Beale AFB), Robert Husk (Portage Environmental), Robert Reeves (RWQCB), Terry Escarda (DTSC), Chuck Elliott (CH2M HILL), Steve Long (CH2M HILL), Leslie Royer (CH2M HILL), Phil Welker (URS), Greg Korose (URS), Scott Dressler (URS), and Tom Cudzilo (URS). This team agreed on the overall approach at the beginning of the investigation, and met during the investigation to make or ratify decisions affecting the direction of the investigation. Collaboration within this group was essential to yield the highest quality data at the lowest possible cost, and to achieve the project goals. Because of Site 40's close proximity to Site 39, it was also essential to coordinate closely with the contractor performing the Site 39 investigation (URS).

Once the draft PA/SI Work Plan (CH2M HILL, 2004) was available for review, the Beale team met to discuss the field approach. Comments on the draft Work Plan were incorporated into the final document (CH2M HILL, 2005). The history of the team's collaboration is summarized in the following list:

- September 28, 2004: Beale team meeting to discuss Phase 1
- October 14 to October 28, 2004: Phase 1 fieldwork
- November 15, 2004: Beale team meeting to discuss Phase 1 results and agree on Phase 2
- December 3 to December 20, 2004: Phase 2 fieldwork
- January 19, 2005: Beale team meeting to discuss Phase 2 results and agree on Phase 3
- February 7 to February 10, 2005: Phase 3 fieldwork
- February 24, 2005: Beale team meeting to discuss Phase 3 results and agree on Phase 4 (final phase)
- June 8 to June 27, 2005: Phase 4 fieldwork
- Use a combination of known historical base practices and field data to identify the source area.

1.3.2 Report Organization

The organization of this report is as follows:

- Section 1: Introduction
- Section 2: Background
- Section 3: Site Inspection Overview
- Section 4: Site Inspection Results
- Section 5: Conclusions and Recommendations
- Section 6: Works Cited
- Appendix A: Soil Boring Logs
- Appendix B: Well Construction Diagrams
- Appendix C: Well Development Logs
- Appendix D: Temporary Piezometer/Well Survey Data
- Appendix E: Groundwater Elevation Surveys
- Appendix F: Laboratory Analytical Results
- Appendix G: Data Quality Assessment

SECTION 2

Background

2.1 Site Description and History

Site 40 is located in the north-central portion of Beale AFB. The site is located near the Cantonment area, west of Site 23 and Hutchinson Creek. The topography is relatively flat in this area. Figure 2-1 depicts the approximate boundaries of Site 40 and the location of Well UBL002MW and the new monitoring wells and piezometers installed during the SI. Figure 2-2 is a photograph of Well UBL002MW, looking eastward toward the Cantonment area. The relatively flat grassland shown in the photograph is typical of the Site 40 area.

The area surrounding Well UBL002MW consists of a grid of streets no longer used as public roads. D and E Streets have been closed to vehicular traffic, but remain in place as walking or running trails. Buildings located in the area during the 1940s were for the most part removed by the 1950s. No structures remain save the roads and underground infrastructure, such as sewer lines. According to the Air Force, the site was developed by the Army in the 1940s as military housing, prior to the Air Force's assumption of the base in the 1950s. Records from that time period are not readily available, but it is believed by the Air Force's Real Property office that the area was used for temporary housing for troops being staged for deployment overseas during World War II. Housing in those days was primarily in the form of tent camps, but this site had more permanent-type structures. Drawings from 1944 show a number of buildings and a series of underground utilities, including heating fuel storage tanks. The buildings were removed in the 1940s and 1950s. The tanks were removed in the 1990s.

A debris disposal area identified as AOC 35 is located to the west of Well UBL002MW, according to a report prepared by Law Environmental, Inc. (Law) in 1995. In addition, a laundry and dry cleaning facility, designated as AOC 12, was believed to be previously located to the northwest of the well, on the north side of 24th Street between E and F Streets.

Present uses of the site are very limited. To the northwest of the site, between E and F Streets north of 15th Street, are parking areas still used for construction and other heavy equipment storage. Otherwise, the entire area is mostly unused, and structures that once occupied the area have been removed.

2.2 Previous Investigations

2.2.1 Installation and Monitoring of Well UBL002MW

In 1996, Law installed Well UBL002MW as part of a basewide hydrogeologic evaluation. This well has been sampled as part of the Basewide Groundwater Monitoring Program (BGMP) since it was installed. When the well was sampled for the first time in October 1996, it was discovered that the groundwater at this location was contaminated with VOCs, primarily trichloroethylene (TCE). Perchloroethylene (PCE), 1,1-dichloroethene (1,1-DCE),

and total petroleum hydrocarbons, gasoline (TPH-g) were also detected. This well was not associated with any ERP site or any known source of contamination.

From 1996 to 2001, the concentrations of TCE increased an order of magnitude in this well. The maximum TCE concentration detected was 225.7 micrograms per liter (µg/L) in July 2001. Since 2001, concentrations have not increased and may be stabilizing. Because of the rising groundwater table during this time, the well screen in Well UBL002MW is submerged about 17 feet.

2.2.2 2001 Field Investigation

In 2001, URS performed a sanitary sewer cleanout and video inspection, a passive soil gas screening survey, and drilled two soil borings (with active soil gas and groundwater sample collection) adjacent to Well UBL002MW (URS, 2003). The sampling locations (Gore Sorber® passive soil gas screening locations and soil borings) and portions of the sanitary sewer line inspected are illustrated on Figure 2-3.

The sanitary sewer cleanout and video inspection was performed first. Grease buildup and minor longitudinal cracks along the top of the pipe were observed. In addition, defects (including cracks and offset joints) were observed at approximately 91.7 feet north of the point of entry at Warren Shingle Boulevard and D Street, and between approximately 193.6 feet north of the point of entry and the first upstream manhole (URS, 2003).

The Gore Sorber passive soil gas screening was performed after the sanitary sewer inspection. Forty-six Gore Sorber samples were collected, several located along the sewer line. Samples were collected near observed cracks and offset joints, and sample locations are shown on Figure 2-3. The results of the soil gas screening were inconclusive—no VOCs were detected, and no VOC source was discovered.

Once the Gore Sorber passive soil gas screening was completed, two soil borings (UB2R001SB and UB2R002SB) were drilled northeast and southeast of Well UBL002MW. These boring locations are depicted on Figure 2-3. Soil gas samples were collected in both soil borings at 10, 20, 40, and 55 feet below ground surface (bgs). The soil gas samples were analyzed for VOCs. The only analyte detected was PCE, at a concentration of 47 parts per billion volume (ppbv) at 10 feet bgs in soil boring UB2R002SB. This concentration is well below the investigation goal (IG) criterion of 670 ppbv.

A groundwater sample was also collected at the water table (at 53.5 and 56 feet bgs) from each soil boring. The groundwater samples were analyzed for VOCs. TCE was detected at a concentration of 0.64 J µg/L in the sample collected from UB2R001SB. No other VOCs were detected in either sample. The results of the groundwater sampling did not indicate a nearby VOC source area, because groundwater contamination observed in Well UBL002MW is found 17 feet below the water table but not at the water table.

2.3 Preliminary Assessment Summary

In 2004, a PA of Site 40 was performed. As part of the assessment, historical aerial photographs from the 1940s through the 1980s were reviewed. Table 2-1 summarizes the review of historical aerial photographs. In addition, historical records and reports were

reviewed. Interviews were conducted with the ERP staff and Beale's Civil Engineering and Real Property offices staff. Drawings depicting previous building locations in the 1940s were also reviewed. The results of the PA were presented in the *Work Plan Preliminary Assessment/Site Inspection at AOC 73* (CH2M HILL, 2005).

The only known removal actions near Site 40 are underground storage tank (UST) removals. UST removals were conducted in the 1990s. Information on USTs in the immediate vicinity of Well UBL002MW is provided in Table 2-2.

During the PA, potential sources of VOC contamination in the Site 40 investigation area were identified and are depicted on Figure 2-4. The following list identifies the principal source areas:

- **AOC 12** (the former Dry Cleaning Facility)
- **AOC 35** (Debris Pile)
- **Site 19/36/39 Area** (Photowaste Emergency Holding Basin, Building 2195 Secure Storage, and Building 2145)
- **Site 27** (Paint Shop Yard and Shed)
- **Site 23** (Former 9th Transportation Refueling/Maintenance Shop), a TCE source area
- **SWMU 23** (Hazardous Waste Accumulation Area), a TCE source area
- **AOC 17** (Transportation Maintenance Compound [Motor Pool])
- **AOC 18** (Waste Oil Application Area)
- **Potential 1,1-DCE Source Area** recently discovered west of SWMU 23

From the data available at the time the PA was performed, the following conclusions were drawn:

- Based on the depth of contamination at Well UBL002MW and the results of URS's 2001 field investigation, the source area for the VOC contamination is not in the immediate vicinity of Well UBL002MW.
- The trend of increasing TCE concentrations observed at Well UBL002MW implies that the TCE plume is migrating. The stabilization of TCE concentrations may indicate that the most elevated concentrations have migrated past Well UBL002MW. If concentrations decline in the future, then the contamination may have resulted from a single discharge. If not, then the contamination may have resulted from an ongoing leak at an upgradient source over time.
- For the purposes of this investigation, AOC 12, AOC 35, the Site 19/36/39 area, and the Site 23 area are all considered potential source areas. However, the current understanding of groundwater flow directions makes AOC 12 and AOC 35 unlikely source areas.
- Groundwater flow directions also make the Site 19/36/39 area (apparently cross gradient from Well UBL002MW) an unlikely source area for Well UBL002MW

contamination. However, ongoing investigations indicate that TCE contamination is widespread in the Cantonment area, and there are apparently multiple sources for the contamination. Site 19 wells have shown a trend of increasing TCE concentrations similar to that observed at Well UBL002MW.

- The Site 23 area may be a source of contamination observed at Well UBL002MW for the following reasons: the upgradient location of Site 23, the uncertainty about the distribution of contamination near Site 23, and the recent discovery of additional VOC sources (PCE and 1,1-DCE) in the area.
- It is likely that the source of contamination at Well UBL002MW was not identified by the PA, and that the source is currently unknown.
- There is no evidence that the groundwater contamination at Well UBL002MW has reached the base boundary. In fact, it appears likely that the contamination does not extent far beyond the J Street gas station, based on concentrations detected in samples collected from monitoring wells at the gas station.
- Groundwater is currently the only known medium impacted, and there have been no known exposures.

SECTION 5

Conclusions and Recommendations

This section summarizes the conclusions of the Site 40 SI investigation and recommends additional work to be performed as part of the Remedial Investigation (RI). The Preliminary Assessment (PA) for Site 40 was conducted for the Work Plan produced during the planning phase for the current Site 40 SI (CH2M HILL, 2005). The PA included a review of historical records and reports (including aerial photographs). It also included interviews with Beale AFB personnel familiar with historical site information such as ERP, Civil Engineering, and Real Estate staff. The conclusions of the PA are summarized in Section 2.3.

5.1 Conclusions from the SI

Four primary VOCs (1,1-DCE, cis-1,2-DCE, TCE, and PCE) have been identified as chemicals of potential concern (COPCs) for Site 40 based on analytical results of in situ groundwater samples collected during initial investigations and from groundwater samples collected from newly installed monitoring wells during the August 2005 BGMP sampling event.

1,1-DCE has been identified as a COPC based on detections above the IG (1 µg/L) detected at the following monitoring well locations:

- UBL002MW (17.8 µg/L)
- 40C002MW (ranging from 0.25 [below IG] to 6.94 µg/L)
- 40C005MW (ranging from 1.13 to 27.6 µg/L)
- 40C009MW (ranging from 3.62 to 53.3 µg/L)

Detections of 1,1-DCE in in situ groundwater samples were also observed during initial investigations above the IG at the following locations:

- 40C001SB (ranging from ND to 2.53 µg/L)
- 40C002SB (later converted to MW, ranging from 0.45 [below IG] to 2.66 µg/L)
- 40C003SB (ranging from ND to 7.81 µg/L)
- 40C005SB (later converted to MW, ranging from ND to 1.72 µg/L)
- 40C009SB (later converted to MW, ranging from 2.97 to 47.7 µg/L)
- 40C011SB (ranging from ND to 1.99 µg/L)
- 40C013SB (ranging from ND to 3.2 µg/L)
- 40C014SB (ranging from 0.16 [below IG] to 1.76 µg/L)

TCE has been identified as a COPC based on detections above the IG (1.6 µg/L) detected at the following monitoring well locations:

- UBL002MW (175 µg/L)
- 40C002MW (ranging from 1.43 [below IG] to 38.5 µg/L)
- 40C005MW (ranging from 13.4 to 282 µg/L)
- 40C009MW (ranging from 13.8 to 158 µg/L)

Detections of TCE in in situ groundwater samples were also observed during initial investigations above the IG at the following locations:

- 40C001SB (ranging from 10.5 to 34.2 μg/L)
- 40C002SB (later converted to MW, ranging from 3.19 to 18.7 μg/L)
- 40C003SB (ranging from ND to 70.1 μg/L)
- 40C005SB (later converted to MW, ranging from 10.2 to 21.9 μg/L)
- 40C009SB (later converted to MW, ranging from 20.7 to 313 μg/L)
- 40C010SB (1.72 to 10.6 μg/L)

PCE has been identified as a COPC based on detections above the IG (2 μg/L) detected at the following monitoring well locations:

- UBL002MW (11.2 μg/L)
- 40C002MW (ranging from 3.27 to 63.9 μg/L)
- 40C005MW (ranging from 0.23 [below IG] to 9.88 μg/L)
- 40C009MW (ranging from 0.29 [below IG] to 4.25 μg/L)

Detections of PCE in in situ groundwater samples were also observed during initial investigations above the IG at the following locations:

- 40C001SB (ranging from ND to 4.65 μg/L)
- 40C002SB (later converted to MW, ranging from 2.84 to 40.6 μg/L)
- 40C003SB (ranging from ND to 2.22 μg/L)
- 40C008SB (ranging from 0.23 [below IG] to 2.09 μg/L)
- 40C009SB (later converted to MW, ranging from 0.26 [below IG] to 2.16 μg/L)

Cis 1,2-DCE was detected above the IG (6 μg/L) at a single location, 40C009MW (ranging from 0.75 [below IG] to 8.67 μg/L), and from the in situ groundwater samples collected at 40C009SB (ranging from 2.42 [below IG] to 13.1 μg/L).

While trace levels of other chlorinated hydrocarbons and organic constituents associated with fuels (e.g., benzene and toluene) were also detected in various monitoring wells and in situ groundwater samples, none were ever detected at levels above their respective IG. Ongoing groundwater sampling in the Site 40 area will continue to assess VOC contamination.

The exact source(s) of VOC contamination in groundwater was not identified during the Site 40 PA/SI. Similarly, the horizontal and vertical extent of groundwater contamination has not been delimited by the SI. However, considerable information on groundwater conditions was developed during the SI that could facilitate future investigations. The following conclusions may be drawn:

- The sources(s) of groundwater contamination observed at Site 40 have not been identified.

- There may be a least two separate sources associated with groundwater contamination at Site 40: one source with higher levels of TCE (and 1,1-DCE) affecting groundwater conditions at UBL002MW, 40C005MW, and 40C009MW and, to a lesser extent, at nearby locations 40C001SB, 40C003SB, and 40C010SB; and a potential second contaminant

source contains a higher concentration of PCE (and cis-1,2-DCE) that is affecting groundwater conditions near 40C002MW.

- The VOC contamination at 40C009MW shows the highest levels of the COPCs (TCE and 1,1-DCE) in the shallow groundwater with decreasing concentrations in the deeper groundwater. This condition suggests that the source of contamination is relatively close to this location. Nearby investigations in cross-gradient and upgradient locations (40C008SB, 40C010SB, 40C011SB, 40C012SB, 40C0013SB, and 40C0014SB) showed low levels of VOC contaminants that are likely associated with more distant sources upgradient in the Cantonment area. It is possible that the contamination seen at 40C009MW is from a more local, shallow source, and may be associated with former buildings shown on Figure 5-1.
- The VOC contamination at 40C005MW shows the highest levels of the COPCs (especially TCE and 1,1-DCE) in the deepest groundwater zones indicating a much more distant source. This groundwater contamination appears to be linked to the contamination seen at other upgradient well locations, including UBL002MW, 40C001SB, 40C003SB, 40C010SB, and eventually 40C009MW, which appears to be nearest the source. This information also demonstrates that the contamination is deeper with increasing distance from the source area.
- The VOC contamination at 40C002MW includes different COPCs (especially PCE). This contamination likely originates from a different source than the other COPCs. This source is probably to the northeast at a distance of several hundred feet or more.
- Groundwater contamination observed at the J Street Gas Station is apparently connected to the Site 40 contamination.
- Although vertical gradients are mostly not observed in Site 40 monitoring well pairs, the data indicate that the contamination becomes deeper as it migrates to the west.
- The vertical and horizontal extent of contamination at Site 40 has not been defined.
- Additional investigation should be performed at Site 40. This investigation should be part of a comprehensive investigation that includes Site 39 and the Cantonment Area.

5.2 Recommendations

Further investigations of groundwater and vadose zone soil contamination at Site 40 are recommended. The goals of subsequent investigations should be to identify the source(s) of VOC groundwater contamination and to define the horizontal and vertical extent of groundwater contamination. The recommendations for Site 40 are as follows:

- Monitoring wells (40C002MW, 40C005MW, and 40C009MW) should be sampled for the next four quarters to identify temporal trends in groundwater contamination at these locations.
- Future groundwater analyses should include TPH-diesel. However, analyses for TPH-gasoline would only be warranted if increased concentrations of benzene and toluene were detected.

- Additional groundwater investigations should be conducted using the Triad Approach. In situ water sampling at shallow, middle, and deep (at least 120 feet) groundwater locations can be used to determine the horizontal and vertical extend of COPC contamination above IGs and to determine the best locations for additional groundwater monitoring wells in Site 40. These investigations should extend downgradient of the J Street Gas Station wells.
- The source area investigations should include searching for shallow soil contamination in the vicinity of 40C009MW.
- Soil contamination can be investigated in the area surrounding 40C009MW by performing a limited GoreSorber © survey around this location. A grid pattern can used to install the GoreSorber © samplers approximately 5 feet in depth. Most of these samplers would be installed on the east side of the well location to the north and south; however, at least several of the samplers should also be installed on the west side near the well.
- It is also recommended that GoreSorber © samplers be installed near the former locations of the storage outbuildings just east of the oxbow channel (2 samplers per structure) to see if the potential source of contaminations at 40C002MW can be identified.